EXCHAN

LIBRARY
UNIVERSITY OF UTAH
MAY 17 1962
PERIODICAL ROOM

# THE SCIENCES

PUBLISHED BY
THE NEW YORK
ACADEMY OF
SCIENCES

*The Sciences*
VOL. 1, NO. 4, JULY 15, 1961

# INTIMATIONS OF AUTOMATION

WHILE the United States is still attempting to accommodate to the economic and social consequences of industrialization, it must face the prospect of adjusting to *automated* industrial output. The country's cultural development over the past century may be insufficient to accommodate the transition without visiting personal economic disaster on substantial numbers of the population. Significant changes, although only premonitory of what is to follow, have already taken place, and a large proportion of those presently unemployed offer documentation to the human cost of a society in rapid transition.

In the 145 years of its existence, The New York Academy of Sciences has participated in the remarkable technological developments in this unique period in the history of Western civilization. As the West prepares to enter an even more remarkable era – The Age of Automation – The Academy's recent conference on Automatic Process Monitoring reviewed the applications of automation now going into effect as well as research trends upon which extensions of automation will be based.

Wiring a lathe to a computer is one aspect of automating a specific industrial function. In the petroleum industry, however, almost the whole process of refining has been automated, rather than single individual functions. Current research planning is directed toward making possible the changeover of entire industries. Since the industries most easily transformed are those involving the processing of materials, as opposed to the assembly of manufactured parts, the oil and chemical industries have been the first to automate; the steel industry is now following.

Hand in hand with automation are the various problems involved in programming computers to relate them to the operation. The extent of computer utilization in the processing industries ranges from simulation – which is not automatic control but a method for deter-

mining on a computer the optimal operating procedures and then initiating them "by hand" – to complete controls operating without the benefit of human assistance.

Automatic monitors check the conditions and outputs of various segments of a process, and instead of moving a dial for an operator to see, they can feed directly into a computer. Instead of signalling to the operator how to vary the operating conditions in a given process stage, the computer can reset the devices which regulate that phase of production. This procedure is extremely complicated because it requires everything there is to be known about running a processing plant to have been programmed into the computer. Often, this information is not available. The process may at some point, for example, involve determinations and corrections of viscosity, and fluids do not always behave in a "Newtonian" manner.

Donald W. Brookfield and Richard A. Minard described some of the principles involved in viscosity monitoring at The Academy conference. Newton, they pointed out, was the first to give a precise mathematical definition of viscosity. In Newtonian fluids this viscosity is a constant; in most fluids, however, the viscosity changes with the rate of movement. These non-Newtonian fluids will thin out as they move faster, or, in some cases, thicken almost to the point of solidity. Water or mercury furnish examples of Newtonian fluids and mixtures of almost any kind from concrete to cake batters exemplify the non-Newtonian.

## New Science

Another difficulty with some of the non-Newtonian fluids is that they carry around a built-in history of their own: the viscosity not only changes with the rate of movement, but with the length of time the fluids have been moving. The complexities of flow are such that the new science of *rheology* has come into being for its study. The rheologic aspects of automatic control are so complicated and subtle that instrumentation is both elaborate and costly.

By the time a process is amenable to automatization, the actual cost of the computer is less than the cost of monitoring instrumentation and programming. For this reason, it is expected that most computers used in process control in the immediate future will not offer complete control. Rather, they will rely upon human intermediates – whose nervous systems are slow but versatile, and capable of self-programming after adequate training – to carry out the control measures the computers will call for.

# ROCK GONGS

THE THEORY that rock gongs form a part of a prehistoric, megalithic culture complex of Europe and Africa, and perhaps elsewhere, is not the only possible interpretation for the rock gongs found recently in Africa, according to Francis P. Conant, Department of Anthropology and Sociology, University of Massachusetts. (Rock gongs differ from lithophones – stones and rocks modified in various ways to alter or improve their sonic characteristics – in that they are left in their original state. They may be as large as a locomotive or less than a cubic foot in volume).

The "culture complex" usually spoken of consists of three elements: The gongs themselves, rock paintings, and rock slides of the type that one literally slides down using some device, including stone, as a sled. Find one of the three, and there is a good chance – according to those who hold the view of a culture complex – that the other two will also be found.

Dr. Conant, in a paper presented before the Academy's Division of Anthropology, acknowledged that these elements are frequently found in conjunction, but he does not find the conjunction to be universal. In Dass, Northern Nigeria, he found rock gongs, but not in association with slides, and "no rock paintings have been found in Dass despite my best efforts at their discovery. . . . If the simple conjunction of gong, slide, and paintings is to be the basis for assuming some inherent nexus among them, it would seem necessary to demonstrate that each element is associated with the other two more frequently than chance alone would permit. No one thus far has shown that such a greater-than-chance correlation exists. A sufficient explanation for their occasional conjunction would be that gongs, slides and paintings all employ a common material: rock."

Rock gongs have been found in Portugal, Wales, Brittany and England. The first reported African examples were found in 1956 in Northern Nigeria by Bernard Fagg of the Nigerian Antiquities Serv-

ice. Since that time, more than 30 such gongs have been found in Africa.

The rocks are played with a hammerstone, often a lump of quartz or quartzite, but something more fragile than the gong itself. The expert player turns the hammerstone as he plays, and it is soon worn into a spherical shape. The gong shows only "chatter marks," which Dr. Conant describes as small, cuplike depressions " . . . caused by repeated nonrandom striking of the rock. . . . These chatter marks appear along the perimeter of all ringing rocks that are, or have been, in regular use as gongs."

Rock gongs discovered in Dass, among the Bankalawa and Barawa, " . . . are used in two different contexts: as warning devices and as paraphernalia associated with the ritual of initiation." Nine of the gongs were located at positions overlooking approaches to villages and where they could have been used as signalling devices by a sentry.

In Dass, Dr. Conant observed, " . . . gongs are owned or controlled by individual cult leaders who are in competition with each other for clientele and followers. The lure of the unknown, the power of suggestion, hints, and rumors, are all psychological weapons of the cult leaders, and the air of mystery they encourage pertains as much to rock gongs as to any other item of ritual equipment."

## Old Secret

The pagan initiation ritual in which the gongs are used " . . . takes place every four years among the Barawa, and five or seven years among the Bankala. Cult leaders set aside their rivalries to cooperate – albeit sometimes unwillingly – for the purpose of staging the initiation rituals, which includes a period of isolation of the initiates lasting from one week to one month. Persistent questioning of informants at the Bankalawa village of Lir yielded the information that the gongs . . . had been given them 'in the time of their ancestors.' "

One explanation for the belated gong discovery in Africa is that their use in ritual is shrouded in secrecy, and that the chatter marks are quite inconspicuous and often overgrown with lichens. Dr. Conant, who spent 1957-59 in Africa as a Fellow of The Ford Foundation, stated: "Without Fagg's original discovery, it is entirely possible that I should have remained ignorant of about 14 gongs in the area where my own fieldwork was carried out in Northern Nigeria."

As an alternative explanation to the "culture complex" theory of rock gongs, Dr. Conant suggests that their use in Africa may mean only that they are a locally available substitute for the more scarce iron gong. "The significance of rock gongs then," he observed, "might be largely in terms of the diffusion of iron metallurgy in Africa, associated by some prehistorians with the spread of the Bantu-speaking peoples." What we now have, he believes, is " . . . the complex subject of rock gongs, rather than a rock gong complex."

IN 250 B.C. ERATOSTHENES of Alexandria developed, on the basis of logic, a concept of Earth as a sphere; then he proceeded to arrive at its size by observing the difference in the sun's elevation from two points a measured distance apart along a meridian. And, although the invention of the telescope represented a major step forward in astronomical calculations, Newton arrived at his formulation of modern mechanics from observational data that antedated the telescope.

Prior to 1932, man's knowledge of the universe was based upon optical observations – with and without the aid of the telescope. In that year, however, Karl Jansky was assigned by Bell Telephone Laboratories to study radio interference (static) associated with thunderstorms. He found that there was a maximum fluctuation in interference coinciding with the passage of the Milky Way across the meridian, and concluded that some of the radio signals emanated from celestial sources. He thus added radio astronomy to the ancient science of astronomy.

The electromagnetic emanations from the stars that we see as light and those that register as static are physically identical, except in the length of the wave or frequency. Visual light has a wave length

ranging from 3.8 to 7.6 ten thousandths of a millimeter. Radio waves currently in use vary from about one inch to a mile or more. The length of these electromagnetic waves determines the means by which they can be studied.

Since earth's atmosphere acts as a filter for both forms of the radiation, wave lengths shorter than blue and slightly greater than visual red are blocked at sea level. Many radio wave-lengths are also blocked by the earth's atmosphere to limit the observable band to from one-half inch to ten yards. Dr. Richard Emberson, in a review of radio astronomy before The Academy, used acoustical terms to convey an image of the two bands: " . . . the radio band is approximately eight to ten octaves wide, whereas the visual band is only about one octave."

## Weak Signals

Signals studied by radio astronomers are quite weak. They may amount to no more than one watt of power over the entire surface of the earth. And the typical radio telescope of today deals with one billionth of a billionth of a watt. The nature of a celestial radio signal is static accompanied by random modulation. "The variation of signal strength or intensity with wave length is sometimes so sharp or pronounced that a particular wave length or frequency can be ascribed to the celestial source. In other cases, the radiation is said to be 'thermal' because it covers the observable spectrum with only gradual variation."

Our own sun is the only star that has been "observed" by radio signal. If its position were shifted to that of the nearest stars, present instruments would be incapable of detecting its emissions. A number of earth's closer neighbors, however, have been observed by radio. "Venus appears to be warmer than expected. . . . Jupiter emits in a most curious fashion." Extremely energetic and sporadic bursts are found in a narrow wave-length band. "The source . . . slips a little with respect to the rate observed for the equatorial belt of Jupiter." At other shorter wave-lengths, emissions are intercepted " . . . that cannot be explained by a simple hot body or thermal source. . . ." Dr. Emberson cited F. D. Drake as authority for the suggestion that what is being observed on Jupiter is the equivalent of the Van Allen belts around the earth.

Where the sources of radio waves have been visually confirmed, these have usually been dust or gas clouds in violent motion. "Typical sources of radio signals are the interstellar clouds that visual astrono-

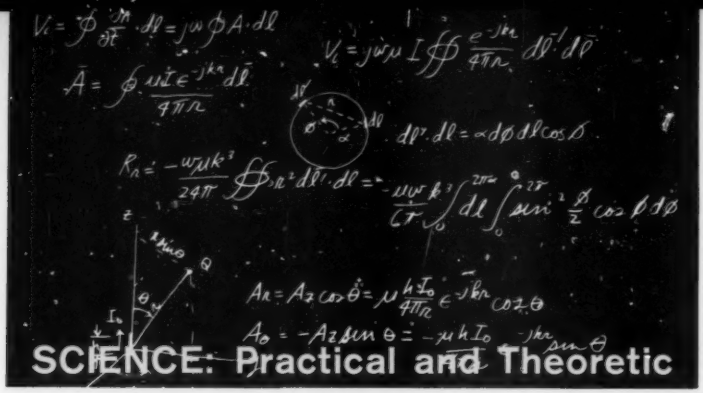
mers had previously plotted. Such sources are not mere points in the sky, like a star, but cover large angular patches and actually fill enormous volumes of space. An unusual source is the Crab Nebula, which is composed of the remnants of a star that exploded in A.D. 1054, as recorded by Chinese astronomers. The dust and gas are still in a very turbulent condition, expanding outward from the position of the former star."

Dr. Emberson reported that the most powerful radio emitter so far discovered is in the constellation Cygnus. "Visually, the source is too faint for observation except with the largest instruments. Apparently, two galaxies are in collision. The consequences of this process exceed anything we could have imagined, and the signal we receive here on the earth is exceeded in intensity by only one other, which comes from a radio source located nearby in our Milky Way. If the Cygnus source were removed so far as to be at the limits of our radio astronomy equipment, the colliding galaxies would be too faint to be observed visually, which has given rise to the comment that radio astronomy can penetrate deeper into the universe than visual observations, and thus holds a major promise for contributing to the solution of the riddles of the universe – the balance between energy and matter and the limits of time and dimension that may apply."

## No Boundaries

Dr. Emberson pointed out that there are no precise demarcations between the domains of geophysics, space, and radio astronomy. "Similar, if not identical, research instruments are used for studying the upper atmosphere and for the exploration of the solar system by means of radar techniques." And while astronomical techniques may be borrowed for a successful space probe, a space satellite could offer astronomers an observation post that would eliminate many of the limitations created by earth's atmosphere. Atmospheric turbulence and the light-scattering and -absorbing characteristics of air and dust would no longer be a problem.

Newton's work utilized the analyses of planetary motion as developed by Kepler via Copernicus and Brahe. The geocentric universe became less ego-inflating, but the sun was still central. Now the sun is seen to be smaller than the average star and is in a sparcely settled region of the galaxy, destroying even that illusion: so we seek the nature of the universe and the place of our Milky Way galaxy in it.




EFFECTIVE EFFORTS must be made to bridge the "great divide" that has split educators in the last ten years on appropriate undergraduate engineering curricula, if this country is to maintain its rate of technological innovation and development.

In a paper presented before The Academy's Division of Engineering, Dr. Felix A. Wallace, The Cooper Union, described the divide: "The professional-minded educator feels the necessity for 'professional' courses somewhat analogous to those given by the medical schools. The science-minded educator believes, because of background or desire, that a large part if not all of an undergraduate engineering curriculum must be science-oriented. In fact, this divide has evolved within the engineering school a separate curriculum devoted exclusively to the engineering sciences. The shift in enrollment to the latter curriculum on the part of more competent students has resulted in a loss of such students to the more standard engineering curricula."

The trend toward "science-orientation" may be reflected in the decreased enrollment in engineering schools (11 per cent in 1958 and 3.3 per cent in 1959) " . . . whether it is the glamor associated with science and research or the type of opportunities available through advertisements typified by those in *The New York Times,* the most able potential engineering student is, instead, pursuing major studies in physics and mathematics. There is no desire to minimize the importance of these two fields and the great impact they have made on modern science. However, to continue to produce theoreticians without a parallel development of men and women who are educated to translate science into useful human needs — which of course is engineering — is to deter the progress of a country whose economic evolution has come largely from the constant development of its technology."

When there has been a greater shift in favor of the engineering sciences to the exclusion of design and application courses, the graduate student often has found himself in a quandary. He has been forced to undergo a lengthy period of adjustment and indoctrination until he was able to appreciate ". . . the practical concepts of design, construction, production, and distribution." The seemingly unlimited wealth sources of industry can face the cost in money and time to provide an internship for the four-year graduate. "The question arises . . . whether such a graduate involved in the various specialized areas of industry really is a technician rather than a professional engineer, with all of the implications that the latter term implies."

The distinction between the two terms "engineer" and "technician" is an extremely fine one. Professional engineers today are described as those who ". . . assume a legal as well as ethical obligation for the accuracy of their works. . . ."

## Time and Learning

The remarkable enlargement in both the basic and applied sciences has imposed a far heavier learning burden on the engineering student, who must be able to utilize them in a professionally competent and socially responsible manner. It has become difficult, if not impossible, for the engineering student to achieve these ends in only four years of study.

A large number of civil engineering educators now favor a pre-engineering curriculum (leading to a bachelor of science degree) that would include the basic sciences, liberal arts, and mathematics. At least three-quarters of the program would be interchangeable between the various engineering curricula. Engineering degrees would be awarded after another year's work, with still more training required for more advanced degrees.

Three of the first four years would consist of a pre-engineering curriculum, comprising: ". . . mathematics (fifteen or more semester hours); humanities, social studies, English and speech (24 or more); physics, including modern physics (12); thermodynamics and heat transfer (6); statics, dynamics, and strength of materials (9); fluid mechanics (4 or more); graphics (3 or more); natural sciences (3 semester hours); measurements and data processing (3); and modern engineering materials (3). The remaining year of the first four years would include the required fundamental courses in any area of engineering and elective courses."

The more capable students would continue into the fifth year

for professional-oriented courses leading to such degrees as M.C.E. and M.E.E. Those who are prone to more complex studies would continue on for a sixth year for such professional degrees as C.E. and M.E.A. A seventh year would lead to a Doctor of Engineering degree.

The program during the first four years would be flexible enough to permit the "research-minded" student to select science-oriented rather than professional courses.

The concensus, Dr. Wallace reported, is that during the next ten years specialized undergraduate training will decrease or be eliminated in favor of a single, basic program. As for the present: ". . . little doubt remains as to the need for a longer period in order to educate a professional worker."

In addition to the educational problem to be solved, there is also the financial. "Most privately endowed tuition schools are already hard-pressed financially. To impose professional curricula in established graduate departments would create an additional financial hardship in terms of additional faculty and space." Such schools would have an undergraduate curriculum that would really be pre-engineering, and the graduate departments would be devoted exclusively to the education of professional engineers, analogous to the existing schools of law, pharmacy, and medicine."

## . . . in brief . . . .

To the two earlier synthetic penicillins with clinical utility, phenethicillin and methicillin, a third has been added – this one with broad spectrum properties. The new penicillin, called "penbritin," inhibits bacterial growth in concentrations as low as 1.25$\mu$gm/ml, which is better in some cases than the tetracyclines or chloramphenicol. The *British Medical Journal* points out that tubercle bacilli, the larger viruses, and rickettsiae will continue to be the domain of the "conventional" antibiotics, whereas in other instances penbritin will make the older broad spectrum antibiotics obsolete.

Penbritin (with the chemical formula 6[D(−)$\alpha$-aminophenylacetoamido]-penicillanic acid) is less soluble than penicillin G, about

equally stable, and equal or nearly equal in action against sensitive staphylococci, streptococci, pneumococci, and a large number of Gram-negative bacteria such as Salmonella, Shigella, Escherichia, Proteus, Pseudomonas, and Hemophylus. (The two major classes of microorganisms are grouped according to their stainability or non-stainability with Gram's stain). Unlike the other two synthetic penicillins, however, penbritin is not active against staphylococci that manufacture the penicillin-destroying enzyme, penicillinase.

---

Magnetohydrodynamics (MHD), while not yet a practical source of power, is getting a good deal of research attention. The concept is rather a simple one, involving the interaction between a magnetic field and an electrically conductive fluid. The fluid acts to generate current, as does the motion of a solid through a magnetic field. This has led to a number of schemes for the extraction of power. Some of these are years away; others are almost in production.

One idea for the use of MHD holds that sea water is a conducting fluid; as ocean currents move through, and cut, the lines of the Earth's magnetic field, an electric current should be generated. The problem would then be to extract it in large quantities in an economic manner.

The fluid need not be a liquid; gases create the same phenomenon. Even a collection of charged particles, as the physicist's plasma, would also serve. A primary difficulty in extracting energy from the fusion process, for instance, is that of containing the thermonuclear reaction. The plasma, however, generates its own magnetic field and interacts with it, and with the magnetic "walls" that are intended to contain it. The unsolved problem of designing such a confining wall is basic to the utilization of fusion as a power source, and is essentially an MHD problem.

In most MHD devices so far constructed, power has been produced for only seconds or minutes – far short of a practical design that will supply energy for years. Although the temperatures of the wall in which MHD units function are not nearly so high as those produced by fusion, the design of the walls poses a number of difficulties.

Since magnetic fields must be quite large, work is now going on to determine the feasibility of supercooled components to make the conductors superconductive. This would permit extremely high-gauss magnetic fields. One aspect of superconductivity is the fact that the

state is destroyed by such extremely high magnetic fields. Different substances vary in their ability to maintain superconductivity in high-gauss fields. Also, while the temperature at which a substance becomes a superconductor is always very low, it does vary, and it is an obvious advantage to have a substance enter the superconducting state at the highest possible temperature. This gives a wide range of potential superconductors with different qualities which must be balanced.

Despite the practical difficulties of using MHD as a source of power, the General Electric Company plans to utilize the concept in the construction of a power plant for space propulsion. This unit will be a closed-cycle type, in which the fluid is recirculated. The fluid will carry a magnetic field that will cut the lines of the magnetic field of the coils, thus inducing an electromotive force in the coils. While it will be more compact and provide more thrust for a similar area of exhaust than a comparable ion-thrust device, it is not expected to actually reach its theoretical efficiency of 56 per cent. There are problems of high temperature in this plant also. Depending upon the kind of fuel used, temperatures are expected to range from 4,000 to 5,000°F.

---

In an attempt to alleviate the shortage of scientific journals in South America, the Pan American Union has organized a program for the collection and shipment of journals of science and technology. The United States Book Exchange will accept files no longer needed by libraries or individuals. The value of the gift and the cost of making it (mailing charges) are tax deductible. For further information, contact United States Book Exchange, 335 V St., N.E., Washington 18, D. C., or the Division of Science Development, Pan American Union, Washington 6, D. C.

---

Those with an interest in sponsoring science education may find a study by The Case Institute of Technology, Cleveland, Ohio, provocative. An investigation by that institution into the professional reading habits of physicists and chemists came up with the remarkable figure of two hours per week as the average time spent by these scientists in reading the technical journals of their fields. Of the time spent in professional reading, 64 per cent is done on the job, 24 per cent at home.

# THE NEW YORK ACADEMY OF SCIENCES

(Founded in 1817)

## BOARD OF TRUSTEES

BORIS PREGEL, *Chairman of the Board*

*Class of 1960-1961*
HARDEN F. TAYLOR

*Class of 1960-1962*
W. STUART THOMPSON

*Class of 1960-1963*
HENRY C. BRECK
LOWELL C. WADMOND

*Class of 1961-1964*
GORDON Y. BILLARD
BORIS PREGEL

FREDERICK Y. WISELOGLE, *President of the Academy*
M. J. KOPAC, *Past President*
HILARY KOPROWSKI, *Past President*
EUNICE THOMAS MINER, *Executive Director*

## SCIENTIFIC COUNCIL, 1961

*President,* FREDERICK Y. WISELOGLE
*President Elect,* JAMES B. ALLISON
EMERSON DAY, *Vice President*
CHARLES W. MUSHETT, *Vice-President*
KARL MARAMOROSCH, *Recording Secretary*
ROSS F. NIGRELLI, *Corresponding Secretary*

*Elected Councilors, 1959-1961*
JOHN E. DEITRICK
CHARLES W. MUSHETT
ROBERT S. MORISON
E. L. TATUM

*Elected Councilors, 1960-1962*
JOHN JOSEPH LYNCH, S. J.
MORRIS SCHAEFFER

*Elected Councilors, 1961-1963*
JACOB FELD
ANDRES FERRARI

*Executive Director,* EUNICE THOMAS MINER

*SECTION OF BIOLOGICAL AND MEDICAL SCIENCES*
CHARLES R. NOBACK, *Chairman*
PRESTON L. PERLMAN, *Vice-Chairman*

*DIVISION OF ANTHROPOLOGY*
ETHEL BOISSEVAIN, *Chairman*
ROBERT HECKEL, *Vice-Chairman*

*DIVISION OF INSTRUMENTATION*
ANDRES FERRARI, *Chairman*
WALTER E. TOLLES, *Vice-Chairman*

*DIVISION OF MICROBIOLOGY*
EMANUEL GRUNBERG, *Chairman*
H. CHRISTINE REILLY, *Vice-Chairman*

*DIVISION OF PSYCHOLOGY*
LOUIS W. MAX, *Chairman*
GEORGE K. BENNETT, *Vice-Chairman*

*SECTION OF CHEMICAL SCIENCES*
FREDERICK R. EIRICH, *Chairman*
A. D. SHABICA, JR., *Vice-Chairman*

*DIVISION OF BIOCHEMISTRY*
RAYMOND L. GARNER, *Chairman*
J. J. BURNS, *Vice-Chairman*

*SECTION OF GEOLOGICAL SCIENCES*
R. W. FAIRBRIDGE, *Chairman*
BARTHOLOMEW NAGY, *Vice-Chairman*

*DIVISION OF OCEANOGRAPHY AND METEOROLOGY*
CHARLES KNUDSEN, *Chairman*
JAMES K. MCGUIRE, *Vice-Chairman*

*SECTION OF PHYSICAL SCIENCES*
HIRAM HART, *Chairman*
ROBERT D. HATCHER, *Vice-Chairman*

*DIVISION OF ENGINEERING*
JACOB FELD, *Chairman*
JOSEPH F. SKELLY, *Vice-Chairman*

*DIVISION OF MATHEMATICS*
BRADFORD F. HADNOT, *Chairman*
MARY P. DOLCIANI, *Vice-Chairman*

*Past Presidents*
M. J. KOPAC
HILARY KOPROWSKI

The Sections and Division hold meetings regularly, one evening each month, during the academic year, October to May inclusive. All meetings are held at the building of the New York Academy of Sciences, 2 East 63 St., N. Y. 21, N. Y.

Conferences are held at irregular intervals, as announced by special program.

# PUBLICATIONS
## PARTIAL LISTING

SOLAR VARIATIONS, CLIMATIC CHANGE, & RELATED GEOPHYSICAL PROBLEMS, Conference Editor, Rhodes W. Fairbridge, Annals, Vol. 95, Art. 1 . . . . . $8.00

MASS SPECTROSCOPIC ANALYSIS OF THE ORGUEIL METEORITE, Conference Editor, Bartholomew Nagy, Annals, Vol. 93, Art. 2 $1.50

GEOCHRONOLOGY OF ROCK SYSTEMS, Conference Editor, J. Lawrence Kulp, Annals, Vol. 91, Art. 2 . . . . . $5.00

AUTOMATIC PROCESS MONITORING, Conference Editor, Sidney Siggia, Annals, Vol. 91, Art. 4 . . . . . $4.00

HUMAN DECISIONS IN COMPLEX SYSTEMS, Conference Editor, Warren S. McCulloch, Vol. 89, Art. 5 . . . . . $3.50

PAVLOVIAN CONFERENCE ON HIGHER NERVE ACTIVITY, Conference Editor, Nathan S. Kline, Vol. 92, Art. 3 . . . . . $5.00

MAN IN SPACE: A TOOL AND PROGRAM FOR THE STUDY OF SOCIAL CHANGE, Conference Editor, M. Mead, Vol. 72, Art. 4 . $1.50

BIOENGINEERING PROBLEMS IN EARLY MANNED SPACE FLIGHT, Conference Editor, R. W. Lawton, Vol. 84, Art. 2 . . . $2.00

PSYCHOPHYSIOLOGICAL REACTIONS TO NOVEL STIMULI: MEASUREMENT ADAPTATION AND RELATIONSHIP OF PSYCHOLOGICAL AND PHYSIOLOGICAL VARIABLES IN THE NORMAL HUMAN, Conference Editor, R. A. Dykman, Vol. 79, Art. 3 . . . $2.50

BASIC BIODYNAMICS, Conference Editor, Edward J. Kempf, Vol. 73, Art. 4 . . . . . $2.00

INSTRUMENTATION, Conference Editor, Joseph Greenspan, Vol. 60, Art. 6 . . . . . $3.00

THE STATE OF AFRICAN MUSIC IN THE FEDERATION OF RHODESIA AND NYASALAND, Transactions, Vol. 23, March, 1961 . . $1.25

*These publications of the New York Academy of Sciences can be obtained by writing to the Academy. Members receive a 20 per cent discount.*

THE SCIENCES is published on the first and fifteenth of each month by The New York Academy of Sciences. A subscription is included in the membership fee. Annual subscription rate for nonmembers: $6.00 per annum.

# THE NEW YORK ACADEMY OF SCIENCES

*2 East 63 Street, New York 21, N.Y.*

NONPROFIT ORG.
U.S. POSTAGE
PAID
NEW YORK, N. Y.
PERMIT No. 8983

THE NEW YORK ACADEMY OF SCIENCES